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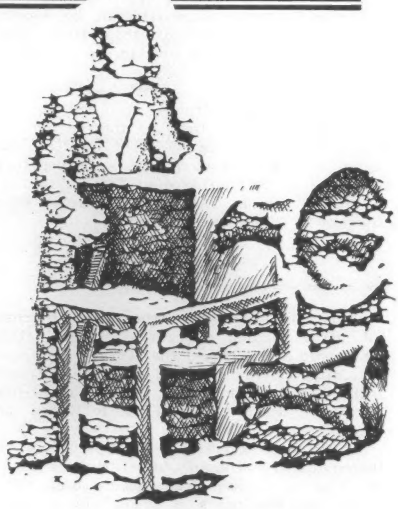
EXPERIMENTAL MUSICAL INSTRUMENTS

FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF NEW SOUND SOURCES

LUIGI IS NOT FORGOTTEN

A new translation has recently appeared of the writings of an important, yet not well-known early twentieth century inventor of instruments. In this issue of EMI we have an extended review of that work, and of the life and times of the extraordinary man that produced it. Also in this issue are an account of a bowed wooden instrument type made & played by the remarkable German guitar innovator Hans Reichel; description of a lovely redwood bass marimba built by Denny Genovese and Tim Treadwell; some practical information on metals for instrument makers; and a lot more. We start here with the book review.



Luigi Russolo (1885 - 1947) was a prominent figure in the Futurist movement in Italy which had its highpoint in the second decade of this century. To realize his conception of a futurist music, Russolo invented, built and performed with a set of instruments he called intonarumori, or noise intoners. Russolo's music and writings have for the most part remained obscure and largely unavailable. Now Pendragon Press has reprinted Russolo's most prominent written work in English. Tony Pizzo reviews it here.

IN THIS ISSUE

Above right: From a photograph of Luigi Russolo.

THE ART OF NOISES by Luigi Russolo
Translated & with an Introduction by Barclay Brown
Review written by Tony Pizzo

"...but pastaciutta is bad for the Italians... by eating it they develop that typical ironical and sentimental scepticism which all too often damps their enthusiasms."

Filippo Tommaso Marinetti

Remaining true to my ethnic and aesthetic sensibilities, this will be a review in the tragic-ironic mode.

As I began reading The Art of Noises, I fully expected to find in Luigi Russolo a mustachio'd Spike Jones with a manifesto. Instead I found a thoughtful but intense visionary whose noise machines and writings on the nature and place of "noise" put him miles ahead of his contemporaries

(Continued on page 13)

LETTERS

I am perturbed by the casual use of PVC pipe for the construction of musical instruments. Although it has many virtues, may I remind people that PVC stands for **poly vinyl chloride**! When heated it releases chlorine and other noxious fumes. It is also water miscible, meaning that it "dissolves" slightly in water. Some states including California no longer permit the use of PVC pipe for drinking water systems. Putting one's mouth on or around PVC is not a good idea. Constant handling is also probably not a good idea. It is not healthy to smell PVC fumes while forming the pipe. Surely, we should not be encouraging and spreading the use of this stuff! Use ABS pipe; nylon, lucite and acrylic are also OK.

I have exhibits of my instruments and performances coming up in Athens, Ohio and Hartford, CT [see notices section for full information -- ed.]. I'm also finishing up my paper on "Complex Pre-Columbian Flute Systems." It will hopefully be published by the Smithsonian Institution as part of the quincentary conference "Musical Repercussions of 1492" -- in a textbook.

Susan Rawcliffe

I usually stay out of the tuning discussions, but after reading and rereading the article on inharmonic partials and the letters that resulted, including one that dropped the name of one of my instruments (Waterphone) in a quasi-humorous fashion, I decided to make the following observations.

It is most difficult to separate a partial (harmonic) from the instrument that is amplifying it. That is to say that a sound does not exist alone, as one hears a sound via a series of plates, resonators, sympathetic strings, or air cavities. When all of these plates, resonators, air cavities, etc. are vibrating at once the overall tone produced is the prime tone of any given instrument. Any vibrating system (strings, reeds, rods, bars, etc.) that have fundamentals or partials that are sympathetic to this prime tone will be greatly reinforced, and likewise those that are not sympathetic will range from dissonant to flat or dead. Among the partials that are dissonant there will be a wide range of qualities, from squeaky to buzz tones to pulsing beats. Some of these partials will be quite harsh, while others will be mysterious or interesting or ? Most instruments are tuned so that the majority of fundamentals and partials are reinforced by the body of the instrument. This is complicated in instruments with microtonal tunings where the fundamentals become almost identical as the partials become closer to each other.

In the case of the Waterphone the tuning has evolved from a visual approach (my background is fine arts) to a non-conventioal audio approach. The question with any instrument is how to make it sound better (more interesting - wider range - more variety.) Aside from reconstructing the body of the instruments, the tuning is most often the way of improving the sound of an instrument. With the Waterphone the tuning evolved by listening to the prime tone of the instrument and those tonal rods that were reinforced by the prime tone. The next steps were tuning those rods that were not sympathetic to the prime tone to those rods that were sympathetic. What I end up with is not a scale but rather a hybrid between a scale and a chart or score. Those partials that are harsh I change until they have a quality that relates to adjacent partials in a less dissonant way. This is complicated when water is used in the interior of the resonator to promote acoustic echoes and

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bend tones, but the Waterphone is tuned before the introduction of water. I do not attempt to tune all of the dissonance out of the Waterphone but rather to reduce it to the point where those partials (or fundamentals) give an interesting contrast to those tones that are in sympathy to the prime tone.

Richard Waters
Sebastopol, CA

Congratulations on the bentwood chalumeau! What a beautifully simple and original concept! I can't help inventing in my mind, so here's a few thoughts that popped out while I was taking out the garbage or something:

1) Painted, overlaid, or inlaid dots on the bentwood would also give approximate pitch locations. I'd use overlays as they would be tactile. It would be easy to carry with the bentwood fastened down.
2) Does the width of the slot make a difference? If so, you could easily make the slot taper by sawing the tube with a wedge 'twixt it and the rip fence. Maybe that would make the pitch locations more logarithmic. Also, the near end of the bore would be more nearly round.
3) For bentwoods with more perfect springiness, thickness, material, shape, work with a lute maker. A bentwood is very much like a lute rib! Try yew wood -- famous for resiliency and tone.
4) I wonder how much that long wooden tongue is resonating, and if that's a factor in tone?

Tim Olsen

[Tim: I would if yew wood. -- ed.]

ADDITIONAL NOTES FROM RECENT CORRESPONDENCE

Pearl Bellinger is an EMI subscriber with an interest in instruments from natural materials, as well as a special interest in biblical instruments. After reading EMI's recent articles on horn and shell, she has written to let us know of some additional sources for both information and materials which she has found valuable:

Benfane Arts (320 Hempstead Ave., West Hempstead NY 11552) has seashells, including strombus gigas (pink conch) and the more expensive charania tritanis (Tritan's trumpet), which are good for conch shell trumpets. As an additional service Benfane Arts can grind the end of the shell to allow for carving a mouthpiece.

The Biblical Archaeological Society (3000 Connecticut Ave. NW, Suite 300, Washington DC 20008) has shofarim of ram's horn in three sizes.

(continued on page 4)

CORRECTION

Three typing errors occurred in the article "Maurice Ravel and the Lutheal" by Hugh Davies in the September issue of EMI. The French instrument name "Ondes Martenot" was incorrectly spelled as Martinot. Sybil Marcuse's first name was incorrectly spelled as Sibyl. Page 13 column 1, last paragraph second sentence should read, "In his patents Cloetens had proposed using more than one set of jacks for different nodes [not "notes"] on the strings ..."

Apologies to Hugh Davies and others affected by the errors, and to EMI's readers.

Trocar Slide Whistle; actual size.

13 GA. TROCAR SLIDE WHISTLE: Pictured here is what must be the world's tiniest slide whistle, made by Jeff Kassel. It is 4½" long not extended; with a sounding tube diameter of about 1/16" inside and 3/32" outside. A trocar (from which it is made) is a medical instrument used to puncture and withdraw fluids or tissue from the organs of medical patients. The plunger is used to remove clogs which might form in the needle's interior. This particular example has never seen action in that role.

To construct the whistle, Jeff cut the plunger short, using some of the cut-off, after filing, to form the windway that directs the air against the sounding edge. The edge itself was formed with a file, and deburred by running the plunger through the tube. The original instrument's tip was blunted by filing, to prevent unintentional mouth surgery.

With a tiny dab of lithium grease on the tip of the plunger to improve the seal, the instrument has a working range of about an octave. Below that the tone degenerates, perhaps due to the large length to diameter ratio. Proper wind pressure (very light for the lower part of the range) is essential.

For information on biblical instruments she recommends several bibliographic sources:

Magic and Old Hebrew Sound Instruments, by H. Avenary
The Shofar, by Cyrus Adler;
History of Musical Instruments, by Curt Sachs;
A History of Hebrew Worship and Celebrations, by Abram Ildelsohn (which gives instructions on the making and playing of the shofar, as well as its ritual use); and
Music in the Bible, by Paul McCammon.

Here in the San Francisco Bay Area we are fortunate to have KPFA listener-sponsored radio. Sometime after our last issue's articles on horn, bone and shell went to press, I happened to hear on David Mayer's world music show recordings of the Tukano Indians of Colombia, playing instruments which would have been worth describing in those articles. The Tukano people make a snail shell flute, which produces a set of light, fine, high whistling pitches. They also play a deer bone flute and a tortoise shell sounded by friction, as well as pan pipes, in music which celebrates their origin myths.

INSTRUMENTS

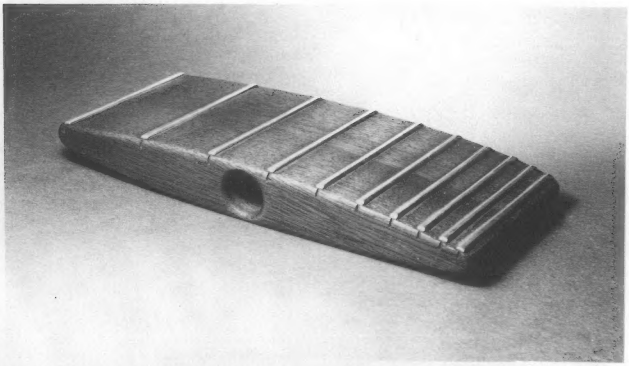
DACHSOPHON
By Hans Reichel

Hans Reichel is a German instrumentalist and instrument builder. He has concertized with various ensembles including many of the avant-garde notables in the US, Europe and Japan. Since 1972 his emphasis has been on solo concerts using his homemade guitars and an array of extraordinary guitar extensions and alterations. Since 1972 he has produced ten LPs, the most recent of which is the 1987 solo release, The Dawn of Dachsman: 12 Guitar and Dachsophon Solos, available from Free Music Production, Behaimstrasse 4, 1000 Berlin 10, West Germany.

In the following I'll try to talk about a quite complex, though rather unpretentious looking musical instrument which I made in 1986. I call it Dachsophon (Dachs is the German word for badger), and have played it in concerts of improvised music since then, alongside my "usual" guitar work. The sounds it emits have been described as "eerily vocal" -- in fact, it's not exaggerated to say that you can make this instrument talk, sing, cry, grunt, whistle, grumble, shriek, yawn, yodel, and whatever -- but very often these noises are colored by a strange, sick, unearthly expression. It can sound pretty melodic too, sometimes not unlike a flute or other wind instruments. It can remind you of soundtracks for weird, unheard of animation films, or of "tormented animals in a queer veterinarian hospital" as a reviewer wrote somewhere. Another one fancied to hear some "pissed off cats," as well as the croak of a bullfrog. Be that as it may, when you see the sound source of all this, you might think it's a joke.

It is nothing but a flat stick of wood (a ruler, for example) clamped to an edge of a table. If you take a bow, preferably a strong double bass bow, it's not big news that you can squeeze some more or less interesting noises out of this arrangement, and even alter the pitch of the sounds, just by pressing your fingers or something else on various points of the stick while bowing it. This way of doing things is not very efficient, but not unpromising either. To be brief, one fine day I took the curved block of wood which you can see in the photo below. Originally I had made this object to fool around with on guitar strings -- but when I started pressing it here and there on the stick clamped to the table, moving it like a seesaw while operating the bow with the other hand, I was quite stunned by the clarity and flexibility of the notes coming out of this dull stick. It seemed to be suddenly animated by that block, which was obviously functioning like a kind of "oppressive" mobile fingerboard.

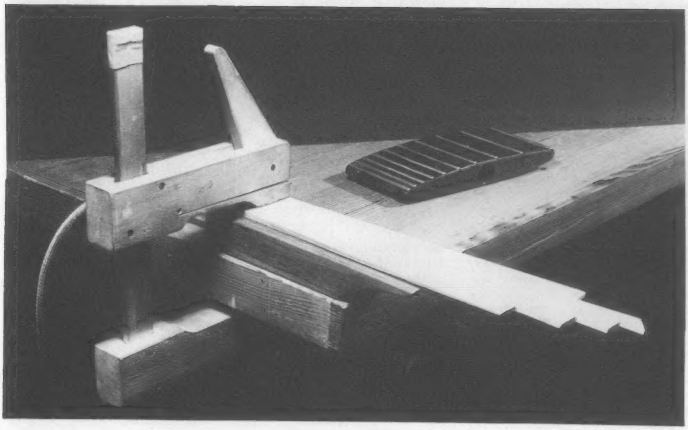
As you see, both sides of the dax (that's how I simply call the wood block now) are slightly curved. One of them is plain, for playing slide notes; the other one has guitar frets which en-



At right: THE DAX

Below: THE DACHSOPHON, ready to play

Photos by Hans Reichel.

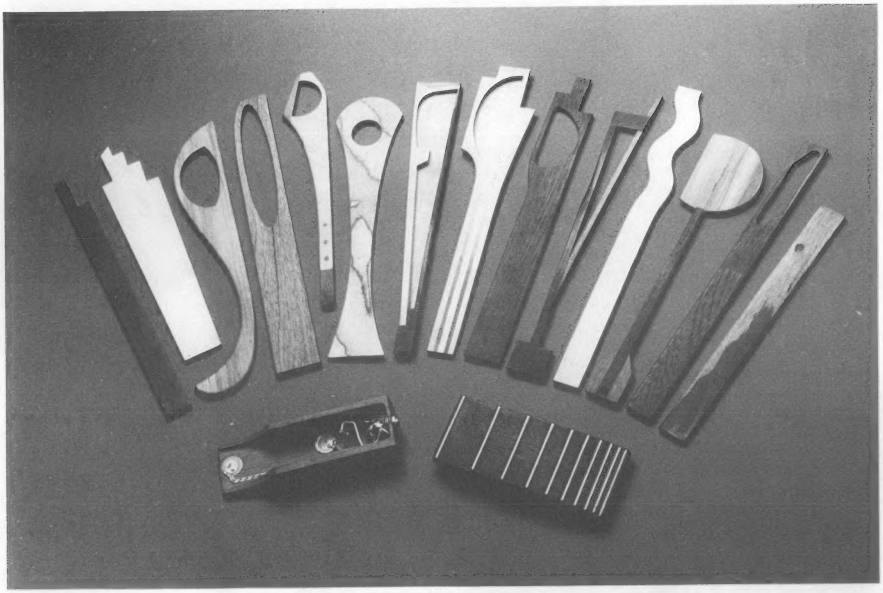


able you to play scale-like passages or distinct melodies, so to speak. The position of the frets results from a logarithmic succession chosen at random, and the hole in the middle of the block was made for better handiness. Moving the dax near the clamp will produce very low notes, because the major part of the stick can vibrate freely. Moving the dax closer to the far end or closer to the point of bowing will evoke higher notes, for obvious reasons -- actually you can get sounds going up to the limit of the hearing range. However, you can't generalize this behavior of the stick, as you can do with that of a vibrating string: there are always a few points where a scale is interrupted, giving way to a lower or higher tone. It depends on the bowing technique too -- needless to say, doing it fiercely or tenderly will make the ruler react in very different ways.

Of course, the sound outcome of a stick depends on its material, length, thickness, shape, and position on the edge. If you make yourself a little collection of those pieces, each one with more or less different features, you can enlarge the range and the variety of sound colors considerably.

As for the material, anything which is sufficiently rigid will do unless it is too thick to vibrate audibly. It works very well with metal, glass, etc., but wood turned out to be the most versatile stuff, as usual. Appropriate thickness is about $\frac{1}{8}$ inch, length about 11 - 13 inches, but there is much room for variation.

The shape matters a lot: it is useful to make pieces with more complex outlines, because it makes a difference at which point on the stick the bow is "busy" (if you stroke the tip of the tongue, you will get other sound colors and scales than if you do it at the side edge, or in a corner, for example). You can make pieces with sharp



Fourteen sticks, each of which makes a Dachsophon. They are all made of wood: ebony, spruce, Brazil pine, mahogany, cedar, plywood, maple, rosewood, sandalwood, persimmon-wood, and African wenge (partly in combinations). I shouldn't say they all sound completely different -- but each has a few "personal" features not obtainable in the other ones. For example, the ebony stick on the left has a quite mellow, mild personality, good for playing melodies in the bass- and midrange. The light piece of spruce next to it is decidedly nasty, and you can imitate a lot of poultry with it (thanks to the "teeth" at the tip it has a very wide range of sound colors). When you play it at a certain point, you will be surprised to hear a quite untalented trumpet student in his first lesson, driving the neighbors mad. The sticks with the holes are very good for "singing" when bowed at the thin edges (the dax can easily produce a nice tremolo on its plain side). In a certain range, the triangle-shaped piece in the center can sound very much like a clarinet, the way it is played in the folk music of southeast Europe (but only when you use the fretted side of the dax very fast). The dark stick of wenge (second on the right) is one of the craziest in this collection: you can make a police siren with it, as well as a hysterical Mickey Mouse, and a lot of other strange things which it would be going too far to describe here. I know that all this will sound hard to believe anyway... What all these sticks have in common, more or less, is a certain quality of a ventriloquist -- both funny and uncanny, in a way.

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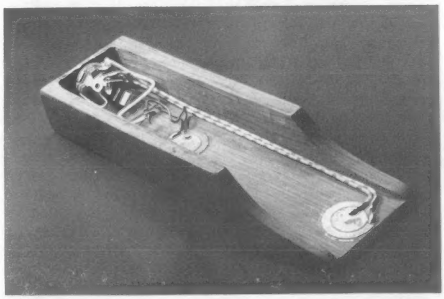
or round edges, with wings, with holes or rifts, or with a thick frame and a thin "soundboard" -- these are actually louder than the other ones.

Talking about loudness: extreme amplification of all this doesn't pose a problem, because there can't be any disturbing feedback. Just attach one or two contact mics to a separate small but solid soundbox, and clamp this together with the stick, as shown in the drawing. Thus you can easily match even with the loudest tenor sax player without loosing one hair of your bow. On the other hand, playing the Dachsophon on stage doesn't seem to look very intelligent -- people can hardly see what you are doing over there, unless they are seated right in front of the thing. Some have even thought I was trying to make a fire, because of the clouds of rosin emitted by the bow. Anyway, it's a delightful and charming contraption



The sound box (with two contact microphones) shown upside down.

(continued on facing page, lower half)

SONOROUS METALS FOR THE EXPERIMENTER
by Rick Sanford

A stroll through a scrap metals yard can be a great inspiration. One sees all varieties of castings, extrusions, beams, etc., and the imagination conjures farfetched musical instruments, kinetic sculptures and the like. One notices that like materials and shapes are grouped together: in one aisle are piles of rusted pipe; this is cast iron. Another aisle has more shiny pipe with no rust; this is stainless steel. A covered area includes grayish aluminum, yellowish brass, and reddish copper. The customer is encouraged to pick through and scavenge at will, and to take potential purchases to the desk, where they are weighed (metal is sold by weight, not dimension) and given a price quotation. Often bargains can be found: an odd lot of small-diameter pipe, a bin full of bowl-shaped aluminum spinnings; and for a few dollars a musical invention can be born.

A visit to a commercial metals supplier is less of an adventure. No picking through or handling of metals is allowed. In fact, customers are usually expected to make purchases over the phone. This is not to say that good bargains are not found at such suppliers: indeed the best quality and service are features of commercial suppliers, and their prices are surprisingly in the same range as salvage yards.

A prerequisite for buying metals is a good working knowledge of all the types available, and a knowledge of a few general machine terms:

ALLOY -- A blend of metals yielding specific characteristics.

ANNEALING -- The normalizing of a metal's grain structure by heating.

DUCTILITY -- A metal's ability to retain its properties after being formed extensively.

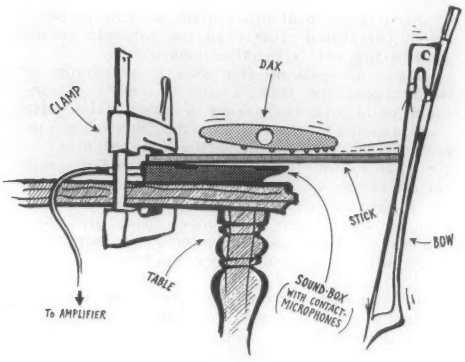
FREE-MACHINING -- Term used to indicate the workability of a metal and the ease with which it can be tooled and machined.

(continued on page 8)

(continued from page 6)

to play with, and it goes very well together with string and wind instruments. What I especially like about it: it's sometimes unpredictable, and always good for a surprise.

Now and then people have asked me why I don't make a more sophisticated device -- a turntable, for example, to the rim of which a large number of sticks is fastened. Maybe the clamp made it look to them like something still in the experimental stage, not yet ready to be introduced as a finished instrument. In fact, one could imagine some more elaborate constructions based on this principle, maybe even in combination with strings. On the other hand, as the Dachsophon is now, it can easily be packed up in a few moments, and be carried away in a small plastic bag -- that's not bad either. And it doesn't need to be a table that it is fixed to. You can clamp it to the frame of a grand piano, or a dog-kennel; whatever the case may be, something will happen... For example, you can create a fine natural reverb by fastening a stick on the body of an acoustic steel-string guitar which has a contact microphone close to the bridge. That mic will pick up the sound of the stick directly (through the wood of the guitar), as well as the sounds of the strings vibrating sympathetically with those tones emitted by the stick which match the fundamentals and harmonics inherent in each string. This is a well-known thing, of course -- but, since the Dachsophon is an extremely "fast" instrument, it is able to produce a big amount of tones and overtones covering almost the whole audible range within a few seconds, if desired -- so the strings can't help but keep on ringing all the time. The result (as sensed by the contact mic) is an impressively dense, sustained, reverberated soundscape.



I think, to introduce "the sticks," that's it for the moment. In case somebody wants to try it out, the only problem would probably be to get the fretted block. But you don't have to be a carpenter to make it, and as for the frets, somebody in a guitar repair shop could certainly help. In case a question arises you can contact me at Ottenbrucher Strasse 2, 56 Wuppertal 1, West Germany.

OXIDATION -- The reaction of an exposed metal to outside elements: rust on steel, corrosion, darkening.

QUENCHING -- The hardening of a metal by heating followed by quick immersion in a cool liquid.

RESILIENCE -- The ability of a metal to be distorted and return to its original shape unchanged.

SHEAR STRENGTH -- The ability to withstand compression without breakdown or deformation.

STOCK -- Another word for material, or metal.

TENSILE STRENGTH -- The ability to withstand stretching without rupture or deformation.

WORK -- When used as a verb ("to work"): the act of fabricating or forming metal; when a noun refers to the object being worked on, as in a "work" of art.

The common metals for sound-producing are:

Aluminum and its alloys

Irons and Steels

Copper alloys, Brasses and Bronzes.

Other metals, such as magnesium or titanium, may tempt the experimenter, but offer little in sound variety beyond the main three classes above. As will be discussed later, exotic metals can also be dangerous or poisonous to work with, and find better application in automobile or aerospace technology.

When I say "sonorous" I refer to a pleasing, resonant sound. A simple measure of the sonorous quality of materials is their "sustain," or length of time vibrations continue after the material is struck. For instance, a church bell is sonorous: a sheet of aluminum foil is not. On one hand is the simple matter of the hardness or softness of a substance, but the "sustain" is also a measure of the overall structure and symmetry of the resonating body. The church bell sustains not just because it is made of a resonant bronze, but because it is cast into a perfect mathematical shape. The strip of aluminum foil is too thin to have much structural integrity, thus it does not resonate at all.

Aluminum and its Alloys

Aluminum is a favorite of musical instrument makers for many reasons. It is lightweight, does not rust, and gives a mellow, long-sustaining tone when struck. Aluminum is used in much metal fabricating, and is therefore available in limitless sizes, thicknesses, and dimensions. Bar stock, sheet, plate, tubing and round stock are all easily obtainable in all in many alloys, even in scrapyards.

Pure aluminum is almost as soft as lead, and can be scratched with a fingernail. It's easy to spot because it also looks like coarse lead: gray and dull. It also gives a dull, lifeless tone. Better alloys include 2024 and 7075 aluminum, both with cobalt and copper as alloying elements (That's right: copper is contained in most aluminum). These are still free-machining and give a well-defined, long tone.

Irons and Steels

Pure wrought iron is known for its shrill "clank." It tends to be heavy and to rust. It is fairly easy to cut and drill, though, and is found in many forms. Tubing, I-beams, and plate all make for good experiments. Iron is also easy to weld, lending the possibility for odd-shaped sound structures. Steels differ from iron by containing carbon, manganese, or other alloying elements. These reduce the susceptibility to rust but also make the material harder to work.

Steels, due to their increased harness, ring longer after being struck, and will have more prominent upper harmonics that wrought iron. Stainless steels (those alloyed with chromium) make for thrilling sound experiments. For one thing, the hardness gives sharp, projecting tones, especially in sheet stock. Stainless steel also has an excellent strength-to weight ratio, making for lightweight, portable instruments! Thin wall tubing is relatively inexpensive, and makes a much clearer tone than ordinary seamed conduit.

Brasses and Bronzes

The main alloys of brass are a copper-zinc combination. Bronze is copper and tin.

This is what bells and cymbals are made of. If they could be made of aluminum or steel, they would be, because brass is not cheap! Or easy to find: commercial uses for brass lie mainly in the electrical contact and architectural cosmetic fields, with a few fittings and washers here and there. Brass is just not available in the variety of shapes and sizes that we find in aluminum or steel.

Which is too bad! Brass gives a rich, resonant sound, pertaining closely to the harmonic series and blending well with other instruments.

Beware of speaking of bronze in scrapyards or metal shops: the term "bronze," from a machinist's point of view, means a brass alloy with lower amounts of zinc, giving the "bronze" a more reddish tint. The common yellow color of brass is due to this zinc, and desires are often for a more mellow silver or red color. Even art foundries use a "bronze" which is mainly silica alloy, to aid in the casting process. Thus, the many bronzes cataloged which are not, in fact, true bronze with an alloy of copper and tin.

All the main three metal types come in great abundance in all scrapyards. Often salvage yard staff don't like to help you identify metals. Sometimes they just don't know (which can be to

one's advantage), but often they would rather not be on the hook for making an incorrect judgment. A good clue is to know what stock is likely to end up at a scrapyard. The reference given later indicates the common uses of all the alloys, and one can easily decode the source of most scrap pieces by viewing their size and shape. Aluminum alloys are the biggest pain area here: they come in so many varieties that virtually all alloys are made in all sizes and shapes. Other areas are simple: one will never find a pipe of cupro-nickel bronze, simply because there is no commercial manufacture of such a pipe. Any brass pipe will, accordingly, be one of two or three other brass alloys.

Prices on scrap metal seem to follow demand. Nobody wants iron or steel, so it's about $1.00 to $1.10 per pound. Aluminum runs around $2.00 to $2.50 per pound, as opposed to $4.00 for new aluminum. Brass and bronze costs roughly the same as aluminum in scrapyards, but these prices end up being the same as new brass. Aluminum seems the bargain since it is made (and used) in such abundance.

Tools and Techniques

Metal can be cut with either a hacksaw or power tool. An electric jigsaw works excellently. Blades for metal cutting will be finer (with more teeth per inch) than wood cutting blades. Also necessary is a cutting oil, not needed so much for lubrication as for cooling the powered blade and material. A great at-home cutting oil mixture is two parts kerosene and one part motor oil. In cutting out metal shapes, it's good practice to mark lines with a heavy pencil or ink. A little testing is needed to find a marker that will not be washed away by the cutting fluid. It's important, though, to mark the metal rather than etching a pattern into the surface, as this produces weak areas in the metal. Not a good idea if the thing is going to be vibrating.

Shaping and smoothing require a file and emery paper or sandpaper. It's nice to have a vise for holding work, and keep in mind that files, like hacksaws, are used in one direction only and do not operate in back-and -forth motion. Pressure on files and hacksaws should be applied only on the forward stroke, and the tool lifted or slid across the material on the back stroke.

Raw metal, like raw wood, needs protection for long life, and can be lacquered, waxed and polished in may ways. Those liking the natural appearance of metal may prefer a coat of paste wax or, as I have done for some seven years now, a hand-rubbed finish of clear shoe polish. No kidding! It's easy to find, cheap, and looks great.

Three main safety precautions come to mind when working with metal: protect your hands, eyes and lungs.

Wear leather-palmed gloves when transporting large metal pieces and working with any size material. Freshly sawed metal has a nasty edge, and it's best to file smooth the surface and throw out the scrap as soon as possible.

Eye protection should be worn whenever any high speed (electrical) tools are being used. This includes drills and drill presses, all sanders, and all saws. The dangers include not only flying material which has gotten into the wrong path of the power tool, but also broken blades, drill bits and sanding disk pieces which can come off a tool at several thousand RPM and do a lot of damage. "Removing a lot of skin" is a common machinist's term, and shouldn't be taken lightly. A pair of elastic-band goggles sells for about two dollars, or a full-faced plastic shield less than ten.

Starting work on a unknown metal is like testing a beaker of clear liquid by drinking it. The third precaution, then, is to know what material you have in your hand. Metals do explode and metals are toxic. It's not like a woodworking shop, where oils and sawdust are organic to begin with and pose little hazard. Metals such as magnesium or titanium pose definite hazards. The only outwardly hazardous of the main three groups is stainless steel, which can give off some unpleasant gases when heated. Brass and aluminum are mainly dangerous in that their dust (from sanding or cutting) is poisonous when inhaled. Metals should be worked in a well-ventilated area and a breathing mask or filter should be worn during cutting or sanding.

All commercial metals are classified and given an alloy number. This information can be examined in specification books in the public library, my favorite of which is the **Metals Handbook** published by the American Society for Metals. It's a thirteen-volume encyclopedia of metals and forming techniques, listing applications and properties of every commercial alloy. In addition to this, manufacturers add warning tags to certain metals, and supply "Materials Safety Data Sheets" by mail to all customers. These sheets define the intended use of all products and go to great length covering possible health hazards.

Once you have an idea what material you are working with, look it up and see if there are any dangers associated with it.

BASS MARIMBAS IN JUST INTONATION

By Denny Genovese

Denny Genovese is a a builder and composer who takes his musical materials directly from the harmonic series. He has appeared in EMI once before (Vol. II #5), with a piece on his Fipple Pipes, long cylindrical flutes without tone holes which naturally produce the tones of the harmonic series. In the current article he describes a pair of bass marimbas, with redwood sounding bars ranging up to five feet in length, tuned to the lower part of the series. Denny built the instruments jointly with Tim Treadwell, a visual artist and sculptor. Tim has provided an addendum which follows the article, describing his role in the work.

Denny joins Christopher Banta, Cris Forster, Blake Mitchell and several other contemporary builders in working with bass marimbas in diverse forms. All acknowledge a debt to Harry Partch, who built bass and very-bass marimbas through the 1950s. His Marimba Eroica employed four bars of sitka spruce ranging in length from about seven feet to something over four feet, and in frequency from 56Hz to 22Hz, each supplied with a large, tunable, individual resonating chamber. The instrument is described in his personal manifesto Genesis of a Music (New York: Da Capo Press, 1974 and still in print).

To take the matter of cultural sources a giant step further: vibrating bar instruments are native to Southeast Asia, Pacific Islands and Africa (South and Central American marimbas are generally thought to have arrived with the slaveships). Very large marimbas exist in several of these places. For instance, the xylophone ensembles of the Chopi people in Mozambique traditionally include the **chinzumana**, a bass instrument employing four keys each about three feet long, with individual tuned resonators in the form of giant calabashes. For a complete account of this remarkable ensemble and music tradition, see Hugh Tracey's Chopi Musicians: Their Music, Poetry and Instruments (New York, 1970).

Denny Genovese's description of the redwood bass marimbas follows below. Anyone interested in further information on Denny's instruments can reach him at PO Box 993, Nokomis, FL, 34274. A cassette of Sarasota's Organization for Experimental Music playing the bass marimba and other Genovese instruments is available, and Denny is available for custom building and consultation.

Ever since leaving Hawaii in 1980, I have longed for the thrill of playing bass marimba. My first one, built in 1978 with assistance from Gabriel Lee, was of course inspired by the one built by Harry Partch many years earlier (see Interval Vol. I #5, "Simple Instruments in Just Intonation" for more on my instruments from that period).

That first marimba (of mine) was originally tuned to components of two diatonic octaves below middle C, but was later retuned to the harmonic series (harmonics numbers 2-9) based on C-32Hz. This later retuning was much more useful to me and is well suited to the vein of research I'm involved in.

There is no way to adequately describe the sensation of being in the presence of such a powerful instrument. The tones are so low that they overlap into the frequency range perceptible by the sense of touch, and the sounds literally vibrate the physical body. This coupled with the natural tuning of the harmonic series produces a stimulating, vitalizing effect that almost commands the body to move.

Rhythmic patterns are naturally reinforced by the powerful, low frequency vibrations of the tones produced, which seems to give the player a graceful endurance that quickly increases in agility and strength. With this in mind, you can imagine what it does for dancers!

Tim Treadwell's art inspired me from the first time I saw it, and conversations indicated that we have much in common philosophically. I played his drums; he played my Fipple Pipes, and eventually we decided to collaborate on an instrument, which came to be Bass Marimba #2.

Tim's artistic design and craftsmanship brought a unique form and character to the instrument, while I looked after acoustic considerations and tuning.

To solve the problem of sharing one marimba between two artists living in different parts of town, we built two. Tim kept the first one and I the second. They are essentially the same design, but different in detail.

The sound producing units are the bars, made of 2x6 clear redwood, suspended horizontally over resonators.

The pitch of each bar is related to its length and thickness. Tuning is accomplished by sawing off length to raise the pitch, while sawing a kerf across the exact center of the bottom of the block lowers the pitch.

Longer = lower = thinner,
while shorter = higher = thicker.

The six inch width of the bars allows them to move quite a bit of air and gives the tone more loudness and strength than would a narrower board.

At first, one would look for a formula by which to precisely calculate the bar dimensions for a given pitch. But every piece of wood has different degrees of density, dryness and perhaps other factors that preclude reasonable accuracy with such a method.

This means that while there are helpful principles and rules of thumb, trial and error is the main technique.

Once a board is cut, other bars cut from the same board will be in fairly predictable proportions; however, another board might give dramatically different pitches for the same lengths.

So, the first principle seems to be to try and get the longest boards possible for making the bars, so that as many bars as possible come from the smallest number of boards.

If it is possible to get all boards from the same part of the same tree, all the better. Also, get very clear lumber, since knots make rattles and distortions.

The tuning progresses from course (rough) to fine. Start with a board of six or seven feet, which is long enough to become the lowest-pitched bar. Lay it on some foam rubber blocks under the approximate locations of the nodes (the support points where contact has the least damping effect on the bar, located about 2/9 of the length from each end), and tap it with a soft, heavy mallet, to see what pitch it is.

At that length, chances are that you'll have to put your ear right near the center of the board to hear it. Now, cut off some of it to see what difference it makes. If the pitch is within a few tones lower than one that you want, start by sawing only an inch or two and work very gradually toward the desired pitch until 1/2 or 1/4 inch increments seem reasonable.

If you cut off too much, making the pitch too sharp, this can be compensated for by taking off some thickness in the center. Commercial marimba builders usually plane the bottom, but a saw kerf will do the trick.

If the pitch is more than a tone or so sharp the board should probably be put aside for a higher pitched bar that needs to be shorter. Then cut a new piece longer than the sharp one and try again.

Two kinds of resonators were used on each marimba. The lowest pitched bar (the lowest is 5 feet long) each got a tubular resonator made from 6" diameter PVC pipe.

Harry Partch provided a formula for calculating resonator lengths:

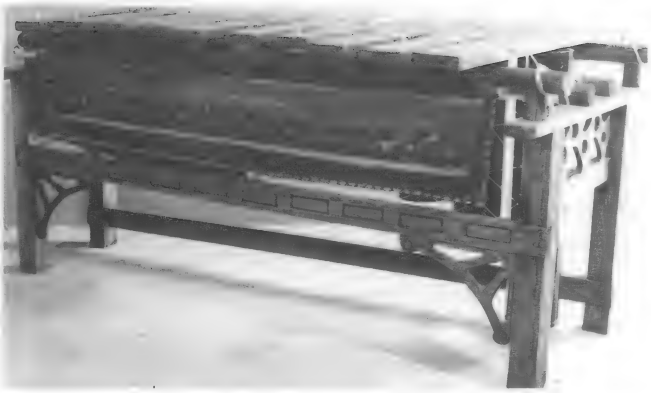
$$\left(\frac{1130\ \text{ft/sec}}{\text{FREQUENCY}} \div 4\right) - (\text{DIAMETER} \times 0.29)$$

But for some reason it didn't exactly work. We found that (maybe because of the very large diameter) the tube lengths calculated for the next higher bar worked better than those intended.

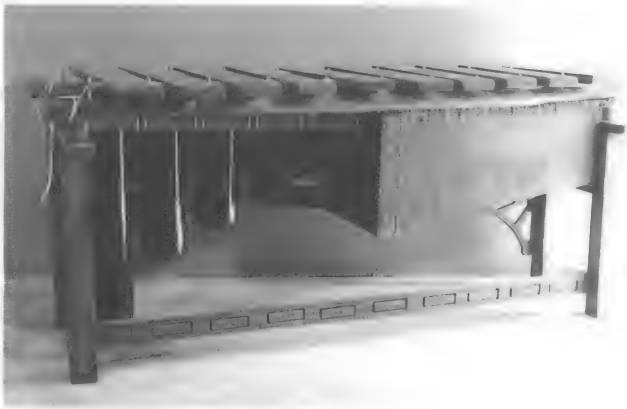
For the type and dimensions of wood that we were using, a rule of thumb seemed to be that the length of the bar between the nodes usually worked well as a resonator depth.

The higher pitched bars required relatively

[1130 ft/sec = speed of sound. Dividing by frequency gives wavelength. Divide that by 4 since these resonators enclose ¼ of the wave. Last phrase is the open end correction factor.]



Photos by Tim Treadwell.



BASS MARIMBA, front and back.

shorter and more precise resonator depths and it was very hard work sawing the pipe by hand, so we decided to use a cave resonator to amplify all of them together. It's just a big, empty box that is the same depth as width. The sides and bottom taper toward the high end of the instrument in proportion with the shorter bars.

Holes were drilled horizontally through the nodes. As mentioned above, the nodes are the best support points, being the points where contact has the least damping effect. This is because the nodes lie between the vibrating middle and the vibrating ends of the bar; in the bar's desired musical mode of vibration, these points themselves do not vibrate. We found the nodes by laying the bars on foam pads in the expected nodal area and sprinkling fine sawdust over them. By repeatedly tapping the bar in the center, the sawdust eventually settles into the area that doesn't vibrate. The bars are suspended by rope passing through the horizontal holes and strung through very large eye bolts.

Good mallets come from solid rubber balls (about 2") drilled and glued onto 3/8" dowels. A three foot dowel cut in half makes two sticks. The balls that dogs like to chew on are good for the lowest bars since they are heavy enough to sound the fundamental strongly, but soft enough not to bring out the upper partials too much.

Superballs are really nice for the higher pitches. The shorter bars are stiffer and this requires a harder ball for optimum volume.

Both kinds of sticks may be used on the entire length, as can dowels without balls, struck on the end of the block for a very sharp sound. The palms of the hands may be used for still another sound.

A somewhat rustic approach was taken to the frame and legs, in harmony with Tim's other sculpture, using both cut lumber and naturally cured saplings.

Tim's marimba plays the harmonic series scale from the second through eleventh harmonics of C-32Hz. Mine uses the same scale except that the 11th harmonic was sacrificed in favor of the addition of an A with a pitch intermediate to the 6th and 7th harmonics, placed at the far end, with its own tubular resonator mounted in the end of the cave.

PITCHES ON THE BASS MARIMBAS

Harmonic Number	Frequency	Pitch Name	
1	32Hz	C	[not used in either marimba]
2	64Hz	C	
3	96Hz	G	
4	128Hz.	C	
5	160Hz	E	
6	192Hz	G	
27/4	216Hz	A	[used in Denny's marimba only: 27th harmonic, lowered 2 8ves]
7	224Hz	Bb-	
8	256Hz	C	
9	288Hz	D	
10	320Hz	E	
11	352Hz	F+	[used in Tim's marimba only]

ADDENDUM TO DENNY GENOVESE'S BASS MARIMBA ARTICLE
by Tim Treadwell

When Denny suggested the idea of building a bass marimba, the idea was appealing because my two- and three- dimensional artistic explorations were leading me on a search for elements of commonality across cultural barriers. The development of art and music are of course common to all the peoples of the earth, and within the categories of art and music there are more commonalities. In visual art, elements that are important to many diverse cultures are exciting pattern, strong use of color, and concern for the intricacies of texture. In music, percussion is inevitable, along with the recognition of rhythm and tonality. These are primal concepts that have stayed important and continue to inspire artists. The marimba project was a chance to work with all of these elements to create a beautiful instrument in a timeless style.

My educational background is in painting and sculpture, but in my approach to music I tried to be as one to whom music is a new concept. Without knowing much about music theory, I wanted to see what realizations about music I could have. After experimenting with building drums for a while, I wanted to increase the variety of sounds that I could produce, so I built a small marimba. It had an accidental scale that was related through the bars being cut from one piece of wood into six lengths with two inch increments in size. I was happy with the results that I was getting, but remained musically naive when we began to build the bass marimba.

The idea behind the collaboration was that Denny would be able to make it sound good and I would be able to make it look interesting. To me, the acoustic and visual components were of equal importance, and I tried to approach it as if I were building a sculpture. I have been working simultaneously with painting, sculpture and sound, trying to create a syntheses of elements that are cross culturally common. This is in order to appeal at some level to a wide variety of people, and hopefully enhance a World Community bond by recognizing similar concerns of all of humanity. It was also important that the finished product reflect a visual organic concern, so it was constructed using low impact technology out of organic and recycled materials.

Books

THE ART OF NOISES by Luigi Russolo
Translated & with an Introduction by Barclay Brown
87 pages, $24 (hardcover), ISBN 0-918728-57-6
1986, Pendragon Press (RR 1 Box 159, Ferry Rd., Stuyvesant, NY 12173)

BOOK REVIEW, continued from page 1

of the first decades of this century. What I expected to be a footnote proved to be a whole chapter, but one with great gaps in the text. Evidently, little more than Russolo's writings remain -- plans for his noise instruments and sound recordings of them, are scattered and rare, and none of the instruments themselves have survived, seriously handicapping our ability to study his work. However, what does remain -- gathered together in **The Art of Noises** -- makes an eloquent case for study and reassessment.

By starting off with some background on the Futurist movement and its historical connections, proceeding through Russolo's **Art of Noises**, and concluding with the instruments themselves, I hope to show how reading this edition of Russolo's writings succeeded at liberating him from my imaginary ghetto of lovable scatterbrained and ultimately ineffectual composers. (I ought to note here that my primary source for this review, particularly with reference to Russolo's writings, the descriptions of the noise instruments and the circumstances of Russolo's life has been the excellent Pendragon edition of **The Art of Noises**, and especially Barclay Brown's comprehensive introduction.)

A BACKWARD GLANCE AT FUTURISM

I heard my one and only snatch of Italian Futurist music back in college while researching Dada and Surrealism. It sounded like steam-driven cartoon music and fit neatly into my ironic appreciation of the artistic movements of the early part of this century, when anyone who could write a manifesto could start a food fight with whomever had written a manifesto the previous week, and all in the Service of Art. Predictably, the Italian Futurists, led by F. T. Marinetti, were the most excessive of the lot -- and while I admired their forceful, imaginative mustaches and skill in outraging the bourgeoisie I was all too aware of the support of Fascism which emerged from their mad edge.

Futurism idolized the tempo and technology of modern life. Marinetti's opening salvo, the 1909 **Manifesto of Futurism**, stated that "a roaring car that seems to ride on grapeshot is more beautiful than the **Victory of Samothrace**."

In keeping with this aesthetic, Futurist music looked to the factory rather than the concert or dance hall for inspiration. Francesco Ballila Pratello's **Manifesto of Futurist Musicians** (1910) demanded that Futurist composers "crush the dominance of the dance rhythm" and called for a microtonal "enharmonicism" similar to Schoenberg's. Pratello envisioned a Futurist music created by the standard Western orchestral instruments. However it was two painters, Luigi Russolo and his assistant Ugo Piatti whose fertile imaginations brought a completely fresh perspective to Futurist music practice. Their accomplishments overshadowed the narrower manifesto-restricted thought of Marinetti and Pratello, and opened up a field of work and discovery which still has much to tell us today.

RUSSOLO'S THE ART OF NOISES AND OTHER WRITINGS

I had some early familiarity with Russolo and his work based on a brief description (and a photo of him and Piatti in their noise lab) in Thomas Holmes' book **Electronic and Experimental Music**. Holmes does Russolo the service of describing his work as seminal in the development of electronic music, but also creates the easy caricature of Russolo as "The Italian Spike Jones." I loved that epithet myself the first time I saw it because it was as ironically charming as all my other images of Futurism. But actually reading Russolo's writings burned off that fog of pasta-induced sentimental scepticism.

Russolo's first manifesto, **The Art of Noises** (1913) shows a refreshing lack of the bombast so prevalent in artistic manifestos of this period. (In fact, Russolo's writings show an increasing mellowness of tone over the years, perhaps a function of his increasing involvement with philosophy.) Most noticeable in **The Art of Noises** is the fact that here is a painter with no formal musical training so totally involved in his commitment to a new musical aesthetic that shortly after he determined to restructure the modern approach to music, he already could set forth not only a coherent philosophical approach to music but also plans for whole families of new instruments. And these noise instruments ("intonarumori") debuted only three months after the publication of his first manifesto! The speed of both Russolo's philosophical and technical development at this point is phenomenal -- it seems that hardly any time elapses between the formulation of a new concept and the planning and construction of an instrument to give it voice. All of the work to follow this manifesto is rooted directly in the themes stated therein.

The Art of Noises concerns itself with Russolo's argument for the necessity of new mechanical means to enlarge the palette of the modern musician and composer. He first draws his own distinction between the two elements at the root of this dialectic -- sound and noise. Russolo defines sound as a succession of regular and periodic vibrations, and noise as vibrations which are irregular in time and intensity. "Every noise has a pitch, some even a chord, which predominates among the whole of its irregular vibrations,"

states Russolo, who intends "...to give pitches to these diverse noises regulating them harmonically and rhythmically." However, this emergent art of noises "...should not limit itself to an imitative reproduction" of existing noise but enlarge the vocabulary of new resonances for its own sake.

Seventy-five years later, how many synthesizer manufacturers and musicians have truly understood Russolo's challenge? It seems that until just a few years ago, synthesizers were promoted primarily on the strength of how closely they could imitate the sound of already-existing western orchestral instruments. Those musicians and composers who have taken Russolo's approach have probably done so intuitively and with a backlog of the experience and technology of over half of a century not available to Russolo.

The following are some points to consider, taken from Russolo's first act of provocation. Roll over, Giuseppe Verdi!

"Ancient life was all silence... Today, Noise is triumphant and reigns sovereign over the sensibility of man."

"This evolution of music is comparable to the multiplication of machines."

Enlarge and enrich the field of sound ... with the addition and the substitution of noises for sounds."

"Noise recalls life itself."

As if this kind of talk were not enough, Russolo goes on to describe, in a fair amount of detail, precisely the kinds of instruments which he will construct to produce these sounds of machinery and the natural world: howlers, roarers, cracklers, rubbers, hummers, gurglers, hissers, whistlers, bursters, croakers and rustlers. More on these later.

A MUSICAL INTERLUDE (AND A CODA)

The first real concert of Russolo's work (utilizing an orchestra of sixteen noise instruments) was held at Marinetti's Milan digs only three months after the publication of the first Manifesto. (This had been preceded by a demonstration of one instrument, a scoppiatore or "burster," before an audience of 2000 in Modena). Two Russolo compositions were performed at Casa Marinetti, relying exclusively on the machines --"Awakening of a City" and "Meeting of Automobiles and Airplanes." (Interestingly enough, the second title echoes Lautreamont's famous image from Maldoror (1868) which surrealists were later to adopt as the "perfect" literary/visual image: "...the meeting of an umbrella and a sewing machine upon a dissection table.") This was the only time at which Russolo allowed the public (and as favorably disposed an audience as he was ever to have) to see the internal works of the machines.

Reviews of the first concerts were mixed, but somewhat favorable. Russolo himself felt that the musicians performed fairly well given the lack of rehearsal, and reported that he was pleased with subsequent performances whenever the musicians had more time to acquaint themselves with the performance techniques which the instruments required.

And when did the first concert riots take place? Just a few months later at the first real public concert/tag team match, held at the Teatro Dal Verme on April 21, 1914. Russolo later concluded that despite his clear representation of intent in The Art of Noises, not one critic had understood either "...the real intuitive principle of the manifesto ... nor ... the logical and practical realization of the principle." It was a concert riot in the grand European tradition of concert riots. Before the full noise orchestra could begin the first of three assiduously rehearsed pieces, the professors of the Royal Conservatory of Milan, some musicians and other music lovers attacked the orchestra (first with jeers and later with physical assaults), unaware that the Futurist contingent was composed of a greater-than-usual ratio of boxers and physical culture buffs who with the "formidable and infallible fists...plunged into the orchestra while I was conducting the last piece." A Parisian correspondent reported that the Futurists "left the battle safe and sound, with only a few scratches. The pastists had eleven wounded taken away by the Guardia Medica." Russolo himself insisted that it was always the academics who started the fights and not the general public, who had a natural interest in the noise orchestra. Final verdict: "The battle of Ernani was a matter of insignificance beside this riot."

While no other concerts matched this one in intensity, Russolo cut a brief but controversial concert swath through western Europe, cut short by the explosion of the First World War, whose decibel level gave even greater inspiration to both Russolo and Marinetti.

After the war, Russolo divided his time between Italy and Paris, but few details are known of this period of his life. There was another confrontation between the Futurists and their new opponents, the Dadaists and early Surrealists, at a 1921 Paris concert which presented the intonarumori in combination with standard orchestral instruments. A performance in Prague in 1921 emphasized their use as sound effects for silent movies, a novelty usage which Russolo pursued as his government pension dwindled. He returned to Paris in 1928 when it seemed that the movie industry was interested in using the noise harmonium for live sound effects in theaters. This hope was killed, however, by the arrival of the "talking film" and a subsequent loss of interest in the novelty aspects of Russolo's work. Noise music had, as it were, run out of steam.

After a few more years of wandering through Europe and turning to the study of yoga and Theosophy, Russolo returned to Italy in 1933, where he lived the life of "a veritable solitary elephant" in meditation and painting until his death in 1945.

OTHER WRITINGS

In The Noises of Nature and Life, Russolo

"AT THE NOISE INSTRUMENT LABORATORY IN MILAN" -- an undated photograph of Russolo, Piatti and the set of instruments.

LUIGI RUSSOLO

Nel Laboratorio degli Intonarumori a Milano.

UGO PIATTI

describes for the benefit of the "pastist" reader how his enjoyment of the noises of the natural world, particularly water ("...the most frequent, most varied, and richest source of noises") has given rise to his aesthetic. Russolo's line of reasoning compares interestingly to Schafer's The Tuning of the World, although each man follows his fancy down a different path. Russolo here makes the point that "...the constant and attentive study of noises can reveal new pleasures and profound emotion," particularly since each manifestation of life is accompanied by noise. Proust needed only a cookie to remind him of his entire childhood, so this assertion may have been made to silence criticism from the French quarter.

And, in what could almost be called an early "ear cleaning" anecdote (see Schafer), Luigi recounts how after five rehearsals of the noise instruments for the Milan performance, the musicians "...told me that they took great pleasure in following the noises of trams, automobiles, and so on, in the traffic outside."

In The Noises of War Russolo waxes rhapsodic on the sounds of war from a trench on the Alpine front, much as Marinetti did with his onomatopoeic "free word" reports earlier form the Libyan War. Keeping a remarkably cool head while doubtless many about him were losing theirs, Russolo notes that whatever the caliber, the pitch of an artillery shell en route "... can equal or even exceed two octaves in a long trajectory." And goes on to observe that "These enharmonic passages... also found in the whistling of the wind... are completely unknown to present-day orchestras, which can only produce diatonic-chromatic passages -- although such enharmonic passages can be quite easily effected with a noise instrument."

The Noises of Language sets forth Russolo's thoughts on the connection between language, sound and noise. He asserts the "vowels represent sound in language, while consonants clearly represent noise." (Or, noise wins 21-5). Again, an interesting comparison can be made to Rimbaud's assignment of colors to the vowels.

In The Conquest of Enharmonicism Russolo deals with the more technical underpinnings of his theories. Since the sounds of nature and industry are obviously not limited to the notes of the tempered scale, he calls for an "enharmonic" music, employing microtones as did the music of the ancient Greeks. He uses the howling of the wind as an example of a natural noise which is rich in overtones, harmonics and the slightest variations of tonality -- a model worthy of emulation by the fully equipped modern composer. "With the introduction of noises in fractions of a tone smaller than a semitone, that is with the introduction of the enharmonic system, even the limitation of sound in its quantity has been removed."

THE INTONARUMORI

Many intonarumori were already at various stages of completion when Russolo's first manifesto, The Art of Noises, was published, and at that time the theoretical framework already existed for the twelve types of instruments to be built. In a later piece, °The Orchestra of Noise Instruments, Russolo fleshed out in greater detail the specifics of the instruments introduced in the first manifesto.

Drawing their inspiration from the noises made by the human voice as well as man-made and natural sounds, Russolo and Piatti quickly cranked out an encyclopedic array of noise makers. The intonarumori were intended to be used either alone or (more preferably) in consort with other noise instruments, although they were capable of being used in the conventional orchestra. After the invention of the noise harmonium, Russolo's interest turned increasingly toward improvisation. Unfortunately (or fortunately, depending on your

musical preferences), none of the intonarumori have survived. There are few (if any) complete diagrams extant, and recordings of them seem to be so rare as to be virtually nonexistent.

The noise instruments were intended to produce noises which encompassed whole microtonal scales along an unbroken (or "enharmonic" continuum, along with as rich a compliment of overtones and harmonics as possible. Russolo wanted to be sure that his machines produced the "rich and intense" harmonics which were to him among the most attractive characteristics of noise.

Basically, the intonarumori were rectangular boxes of various sizes outfitted with horns for amplification. Calibrated levers on the side of each box controlled pitch and volume, and each box was also equipped with a button or crank to excite or stop the vibrations, thereby making possible rhythmic control.

Each instrument consisted of three basic interior elements: a mechanism to produce the noise, a mechanism (such as a handcrank or a motor) to power the noise generating parts, and a device to amplify the noise and control its pitch.

A single diaphragm (usually a drumhead marinated in a special chemical bath) served as the most usual means of amplification. A tensioned wire anchored to the center of the diaphragm usually transmitted the noise to the diaphragm for amplification, serving in much the same fashion as the plucked string of the Bengali string drum called the gopichand. Russolo found that by varying the tension on the wire, he could vary the pitch of each instrument by as much as ten whole tones or possibly two octaves. Since string tension was lever-controlled and did not involve preset stops, it was possible to select tones along the unbroken microtonal continuum, making "enharmonic" experimentation an integral part of composition for the intonarumori. There were twelve different types of intonarumori as listed below. Since none exist in complete form, we can at best make educated guesses as to the complete details of their construction. These descriptions are based on the information which Barclay Brown has assembled.

The howlers (ululatori) created a noise combining the sounds of the human voice, a bowed string instrument and a siren. A sustained note on a howler could be held indefinitely.

The roarers (rombatori) produced a low rumbling recalling the noise of distant thunder.

The cracklers (crepitatori) produced a metallic crackling noise in the higher register, and a metallic clashing in the lower register.

The rubbers (stropicciatori) were characterized by a metallic scraping or rubbing sound.

It is believed that these first four instruments shared a common mode of noise production -- a rotating wood or metal disk with varying types of indentations which turned against the wire anchored to the diaphragm.

The hummers (ronzatore) recalled the noise of an electric motor or the dynamos of electric power pants (always number one on the Futurist hit parade).

We are quite sure that the sound of the hummer was produced by vibrating a small steel ball mounted on a spring wire against the diaphragm.

The gurglers (gorgoliatori) recalled the noise of water running through the raingutter of a house. By engaging the "rain" stop, the noise of rain could be made.

If the steel ball used in the hummer mechanism was allowed to vibrate against the wire rather than the diaphragm, the hummer would gurgle. Russolo later combined both of these instruments -- possibly to be able to reproduce the sound of singing in the shower (number two on the futurist hit parade).

The hissers were engaged with a special stop on the gurglers which caused spring-like wires to rest against the diaphragm.

The whistlers (sibilatore), which Russolo called the most successful of the intonarumori, made a noise like the howling or whistling of the wind.

Based on a schematic which Russolo drew for a patent, it seems that the whistler was composed of three telescoping organ pipes joined to a wind chest which was enclosed on one side by a diaphragm. A metal roller varied pressure on the diaphragm as the pipes were lengthened.

There were two types of Bursters (scoppiatore). The first sounded like an automobile engine, and its characteristic noise may have been produced by the beating of wooden disks against each other. There were stops to produce the noises of engine idling and exhaust as well.

The second type of burster made the noise of dishes falling and shattering, which may have been produced by the vibration of cardboard cylinders.

The croakers made the sounds of croaking frogs.

The rustlers made the sound of rustling leaves or silk.

There are no indications as to the mechanisms used by Russolo for these last two instruments, but he did say that Ravel was particularly fond of croakers and intended to use them in a composition.

The capstone of the noise orchestra was the noise harmonium, which was to unify all twelve basic timbres within an instrument which could be played by a single performer. The design of the harmonium probably involved uniting series of two or more noise producers to each diaphragm. Four were built: the first (built in 1924) and the second had keyboards; while the third (built in 1927) and fourth had levers and were the only ones to produce all twelve timbres within the same instru-

ment.

The enharmonic bow, a grooved metal rod, was another one of Russolo's devices. Used to bow the strings of a violin or cello to produce a sound which resembled that of a guitar or mandolin, it was used periodically by Russolo and other composers of the period.

Plans were also made for an enharmonic piano which was to be a keyboard instrument which used rosined belts to set coiled springs into vibration, hurdy-gurdy style. Springs were to be depressed to change pitch. The piano was never completed due to lack of funds. Had it been build, it could have possibly taken the form of a mechanized prepared piano.

Russolo's rich imagination could probably have cooked up an even greater number of instruments had circumstance and finances cooperated. In an early manifesto he postulated that "...the number of noise instruments that have been found possible far exceeds that of those yet constructed." And, as it happens, he was correct.

INFLUENCES OF RUSSOLO'S WORK

Luigi Russolo was among the first persons to concern himself with many modern musical issues. He bridged the gap between Symbolism, the last major artistic movement of the Nineteenth Century, and the first major movements of the Twentieth: Constructivism, Dada and Surrealism -- many of which he influenced directly. His noise instruments concretized the sound poetry of Marinetti, and both men were direct influences on concrete poetry, musique concrete, musique brut, and the many forms of mechanistic music which followed, from the Dadaists down to present-day "industrial music." Among those with whom he had contact or influence can be numbered Bartok, Ravel, Schoenberg, Cowell, Ives, and later Varese, Antheil, Stravinsky and Cage.

Elements of noise music were used in the early musical accompaniment for silent films. His morphology of sound looks ahead to the digitization of sound. Whether you agree with it or not, his statement that "No musician could ever have the rhythmic richness of machines" sounds remarkably prescient in this period of drum machines. He was among the earliest of modern western composers to make use of microtonality a major element in his work, and developed an "enharmonic notation" to score for the intonarumori.

As a painter who abandoned one art form for another, he shares a similarity with other enthusiastic "amateurs" whose lack of formal training and fiery enthusiasm brings a radical perspective to music as it is "practised."

Like Harry Partch, Russolo was the only one who could build the instruments to produce the sounds he heard as he heard them, and he simply got right down to it, regardless. The pope doesn't have to sign a certificate to put him in my pantheon. There is a freshness and directness in his approach to the simple mechanical production of sound which leaves many avenues for exploration still open.

I think that his concepts of timbre and rhythm are probably only now being recognized on the popular level. The use of a cigarette machine as the rhythm track on Joni Mitchell's "Smokin'" must have given the old boy a chance to say "I told you so." Annea Lockwood's "World Rhythms" is another example which, given the technology, could have come from the Russolo songbook -- tapes of rivers from different parts of the world are combined with tapes of other natural and woman/man made sounds, resulting in a simultaneous representation of every day's rhythms.

Recently it has seemed that Russolo-like statements have been appearing with increasing frequency. A friend recently sent me a copy of an interview with Robert Erickson, who among other things was very influential in the development of the tube drum. Another composer/instrument maker, Erickson says: "In the 19th century, things began to get noisier. We got industrial everything. The orchestra is really a kind of analogue to a factory... If you live in a noisy environment, you are going to make noisy music. I sometimes think of all the 19th century music since the invention of the steam engine, not to speak of the internal combustion engine, as ko-pau-ka-ta-pau-ka-ta-pau-ka-ta music... One of the things that came out of punk around 1977 was that industrial background sound. Turn up every thing until it sounds like a factory!" And Russolo's name is never even mentioned in the conversation!

I believe that the key to Russolo's longevity is the fact that he was truly a futurist -- he understood the inevitability of change so well that maybe we're only ready to consider his work seriously forty years after his death. In The Art of Noises -- New Acoustic Pleasures he states:

"None of this hostility was ever capable of stopping the fated evolution of music. In a sudden change of climate, the most contested of new manifestations ended by being accepted and applauded... The reason for these instances of rapid acceptance lies in the fact that our acoustical sensibility is being continually assaulted by the diversely dissonant chords and the much more complicated timbres found in the noises of life and nature... it would not have been possible for music to evolve so decisively toward dissonance if our ear had not become accustomed to the complex noise of fervid, rapid and intense modern life."

A LAST NOTE

A few words about the book itself. If a resurgence of interest in the work of Russolo does occur, this book will be a major catalyst. Barclay Brown's first-rate introduction brings together a great deal of hard-to-find information on Russolo and how his work relates to the development of the modern musical sensibility. It is equally strong in its coverage of both the technical and historical aspects of Russolo's work,

which is quite an accomplishment in view of the fact there there is not an awful lot of information available about Russolo and none of his noise instruments have survived.

The selection of Russolo's writing which Brown presents provides us with a well-rounded image of Russolo's thought and accomplishments, one which deals a body blow to the picture of him as the "Italian Spike Jones." I don't know whether any other writing exists, but I came away from the book with the feeling that Russolo was well-represented by the selections which were chosen.

Brown recognizes the irony of Russolo's position in history. He states that "no other musician of his time could have envisioned such a sweeping renovation of the materials of music." Yet the scarcity of recorded examples of Russolo's work, coupled with the absence of diagrams for the noise instruments (or the instruments themselves) is an obstacle to a revitalization of interest in Russolo's work. (Hugh Davies, in a forthcoming article on Russolo to be published in EMI, will provide information on some existing recordings of intonarumori.) Ironically, Russolo published no plans for the intonarumori because he intended to have them patented and marketed, but he died before he could accomplish this (EMI readers take note). Brown's written reconstructions of the intonarumori are clear enough to make a sort of experimental reconstruction possible for anyone who would like to try it.

Special thanks are also due to Pendragon Press for arranging for Mr. Brown's translation and publishing this edition of a work which (I have noticed) can sell for as high as $400 for an Italian first edition.

So, despite the high tragedy of the Russolo libretto, in Barclay Brown's presentation he emerges as an enthusiastic but thoughtful visionary whose full influence is yet to be assessed. This book will, I hope, serve as an overture to that assessment.

AN ANNOTATED LIST OF REFERENCES

Electronic and Experimental Music by Thomas B. Holmes. NY, Charles Scribners Sons, 1985.

A comprehensive, non-technical history of experimental instruments and music. A good source for information on the early history of experimental music in this century, a subject not ordinarily covered in books of this sort.

Futurist Manifestos edited and with an introduction by Umbro Apollonio. NY, Viking Press, 1973.

A good cross section of Futurist manifestos, painting and assorted ranting. Includes Pratella's Manifesto for Futurist Musicians.

For further investigation, **Futurist Performance** by Michael Kirby (NY, 1971) may be of interest; and any edition of Marinetti's Futurist Manifestos will present a good overview of the Futurist aesthetic as formulated by Mr. Marinetti, the dynamo-in-charge.

An Interview with Robert Erickson by Dan Dunbar. Percussive Notes Research Edition, Volume 25 Number 3. Urbana, IL, Percussive Arts Society, 1987.

An extended interview with a thoughtful and personable composer/instrument maker.

Before and After Science by Brian Eno. Island Records 9478.

The song "Kurt's Rejoinder" contains a snippet of the Dadaist Kurt Schwitters' "Ursonata," a sound poem related to the Futurist "free word" poems.

[I have a copy of the "Ursonata" taken from the first German publication of this piece and will send a copy to anyone who is interested. Please send a self-addressed 8½ x 11 envelope and $.50 with your request to me at RR#1 Box 64, Lunenburg VT 05906. I, in turn, would be interested in hearing about any other resources dealing with Russolo's work, and especially any recoreded examples of Futurist music or the noise machines themselves.]

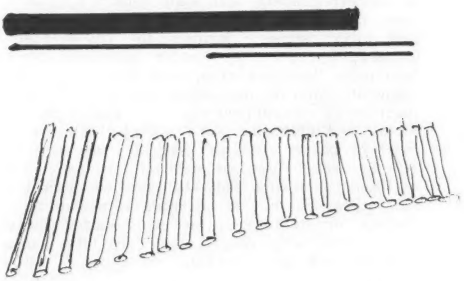
For news about the recent and not-so-recent activities of the intensely Dadaist Bonzo Dog Doo Dah Band and their master of machines, Roger Ruskin Spear, contact D. Cole at **Doo Dah: The Newsletter of the Bonzo Dog Fan Club**, 336 Hoover Ave., Bloomfield, NJ, 07003.

The Tuning of the World by R. Murray Schafer. Philadelphia, University of Pennsylvania Press, 1980.

An important book which deals with our changing perception of sound, particularly helpful in this case where the "difference" between sound and noise is discussed.

Jacques Attali's **Noise: The Political Economy of Music** is a book which I have not read but which probably bears investigating.

Re/Search 6/7: The Industrial Culture Handbook (available through See/Hear, 59 East 7th St., NY 10003) updates the Futurist fascination with mo-dern industrial life and its social repercussions.



ORGANIZATIONS & PERIODICALS

Experimental Musical Instruments regularly reports on organizations and periodicals of potential interest to its readers. In this issue we look at a membership organization and an academic journal devoted to the world of natural sound.

NATURE SOUNDS SOCIETY
Natural Sciences Department
The Oakland Museum
1000 Oak St.
Oakland, CA 94607, USA

BIOACOUSTICS: THE INTERNATIONAL JOURNAL OF ANIMAL SOUND AND ITS RECORDING
ABA Academic Publishers
PO Box 97, Berkhamsted
Herts HP4 2PX, England

The Nature Sounds Society is a membership organization devoted to the appreciation, understanding and preservation of sounds of the natural world, and animal sounds in particular. It was founded in 1983 at the Oakland Museum, where it still has its headquarters. Activities of the society have included publication of a quarterly newsletter, classes and workshops, field trips, and sponsorship of exhibits and concerts. A separate chapter of the Society has recently been established in the Pacific Northwest.

The newsletter contains calendars of events, networking information for members, and occasional short articles. A regular feature is the "Nature/Arts Column," exploring the use of nature sounds in music and the arts.

There also frequently is material pertaining to portable sound recording equipment and its use and maintenance. This in fact is one of the society's focuses. They have sponsored workshops on recording techniques, performed and reported on comparative tests of different machines, and arranged special terms for the purchase of equipment from local retailers.

Last April the Nature Sounds Society sponsored a concert program entitled "New Music with Birds, Frogs and Other Creatures" at the James Moore Theater of the Oakland Museum. Composers Charles Amirkhanian, Bernie Krause, Jerome Neff, Wendy Reid, and Jill Neff were represented. Most of the music used prerecorded animal sounds (in some cases electronically processed), in conjunction with synthesizers or traditional instruments. One piece dispensed with tape and used bird whistles, rattles, wind chimes, musical saw and wind machine.

The Nature Sounds Society is the only membership organization of its sort in North America (discounting ornithology groups with an interest in birdsong). The leading American library for natural sound recordings is Cornell University's Library of Natural Sounds (159 Sapsucker Woods Rd., Ithaca, NY, 14850), with which the Nature Sounds Society maintains a working relationship.

Membership in the Nature Sounds Society is $10/year for individuals; $20/year for organizations. For more information write the address given above.

Just in the last few weeks, a new academic journal devoted to nature sounds has appeared in England. **Bioacoustics: The International Journal of Animal Sound and its Recording** is an outgrowth of the International Bio-acoustics Council, a group devoted to the scientific study of biological sounds, founded in Denmark in 1969 under the auspices of the Danish Natural Science Research Foundation. IBAC formerly published a bulletin called **Biophon**, which reached about 450 IBAC members worldwide. When **Biophon** ceased publication in 1983, talk turned to the creation of a new journal to fill the void. After a long period of gestation, **Bioacoustics** has appeared in that role. In addition to its association with IBAC, **Bioacoustics** also seems to have informal ties to Britain's National Sound Archives.

The new journal covers animal sound communication, bioacoustics research, and wildlife recording techniques and equipment. "Our aim," the first issue editorial says, "is that **Bioacoustics** should be truly international." Indeed, the editorial board very is much so, with members representing institutions throughout the world.

The first issue is just over 100 pages. Six major articles appear, including (as examples), "The Significance of Multi-Note Advertisement Calls in the Reed Frog, Hyperolius Tuberilinguis," and "Incomplete Song Strophes in the Chaffinch, Fringilla coelebs L." Also included are a bibliography of recent publications in bioacoustics, reviews of audio equipment, books and recordings, and news from the International Bio-acoustics Council. A partial list of wildlife sound libraries appears, along with a note that a complete listing will appear in a later issue.

Subscriptions to **Bioacoustics** are available from the address given above. The cost is L55 or US $95, with special lower rates for certain individuals. That covers one volume of four issues (no publication schedule is given; this first issue is simply dated "1988").

NOTICES, continued from page 20

THE MUSIC MAKERS, an exhibition of musical instruments by contemporary makers from around the world, continues through Oct. 16. Traditional reproductions to experimental avant-garde; performances, lectures and workshops. Performances include Susan Rawcliffe, Oct. Sunday 10/9, 1:00 and 8:00 pm, and Sharon Edwards (performance art using a variety of unusual sound sources) on Thurs. and Fri. Oct. 13 and 14, 8 pm. At the Dairy Barn Southeasern Ohio Cutlural Arts Center, 8000 Dairy Lane, Athens OH, 45701. (614) 592-4891 for information.

PASIC '88, this year's gathering of the Percussive Arts Society, takes place in San Antonio, TX, November 16 - 19. For information contact PAS at PO Box 697, Urbana, IL, 61801.

RECENT ARTICLES IN OTHER PERIODICALS

Listed below are selected articles relating to unusual musical instruments which have appeared recently in other publications.

CHRIS SHULTIS by Peter Garland, in Artspace Vol. 12 #3, Summer 1988 (PO Box 4547, Albuquerque NM, 87196).

A review of the work of Chris Shultis, a percussionist who composes for and performs with a wide variety of sound objects, including amplified cactus (played by plucking the spines with a pick). Included with the magazine is a sound sheet (floppy 33 rpm record) containing a Shultis piece for vibes, piano interior, almglocken, metal bowls and wind gong.

INSTRUMENT INNOVATIONS: AN INTERVIEW WITH PETE ENGELHART by John Scoville, in Percussive Notes Vol. 26 #4 (Box 697, 214 W Main St., Urbana, IL 61801-0697).

A friendly and personable interview with a builder of beautiful, imaginative, sculptural metal percussion instruments.

FESTIVAL MUSIQUE ACTUELLE by PeggyAnn Wachtel, in Ear Vol. 13 #5, July-August 1988 (325 Spring St., New York, NY 10013).

A review of a festival which took place a year ago in Victoriaville, Quebec. The review devotes much of its space to several Canadian ensembles using unusual instruments: Tuyu, which uses a diversity of homemade things, Conditure de Gagaku, which uses balloons and party whistles along with standard instruments, and the Glass Orchestra, which performs entirely on instruments of glass. Also appearing were Gordon Monahan, with his piano acoustics explorations, and a number of American performers.

Festival Musique Actuelle is an annual event in Victoriaville; this year's festival will take place October 5-9.

ELLEN FULLMAN/LOIS VIERK by Sarah Cahill, also in the reviews section of Ear Vol. 13 #5 (address above).

A review of a concert which took place at Mills College last March. Of interest to EMI readers here is Ellen Fullman's work with long strings (up to 60 or 100 feet or more), which vibrate longitudinally rather than transversely, to produce pitches in the heart of the musical range.

"HEX": NOTES ON A NEW COMPOSITIONAL PROJECT BY GODFRIED WILLEM RAES in Logos-blad 10e jaar nr. 7, July 1988 (Kongostraat 35, 9000 Gent, Belgium).

Logos-blad, the publication of the Logos Foundation, is normally in Dutch, but this article happens to be in English. It describes a computer controlled electroacoustic performance set-up, in which small acoustic sound sources (strings, lamellae, springs, etc.) are excited by electromechanical means. Their sounds are picked up by a mic or other transducer and analyzed by a computer which then sends pulses (back to the sound source or to a speaker? It's not clear to me which) which are designed to sabotage any regular periodicity in the original sound. Difficult to explain briefly; highly unusual and interesting.

"THE HEARINGS"/VARIOUS CONCERTS by Marina La Palma in the "Viewpoint" section of High Performance #41/42, Spring/Summer 1986.

Reviews of several concerts from this series at P.S. 122 in New York City last fall. One of them was a piece called "Caffeine Effect," composed by Fast Forward for percussion ensemble. It employed his own extended steel drum technique, tom toms and rototoms, and a variety of junk instruments including fast food containers which the performer walked on, reportedly with remarkable effect.

Newsletter of the American Musical Instrument Society Vol. XVII #2, June 1988 (414 E. Clark St., Vermillion, SD, 57069-2390) as usual contains photographs and descriptions of a number of rare and interesting instruments. Among them are a glass harmonicon, and two beautiful new reproductions of Ophicleides built by Robb Stewart.

NOTICES

Just Intonation Calculator, by Robert Rich. Macintosh Hypercard stack makes JI easy: shows scales to 48 notes/octave; calculates transpositions; reduces fractions; converts between ratios, cents, DX7II, TX81Z units; internal sound. Only $10.00. Soundscape Productions, Box 8891, Stanford CA 94309.

WATERPHONES -- Two new models are now available. "Small" for $185 and the "Whaler" -- $295. These stainless steel & bronze instruments are easy to play by bow, mallets & by hand. Write Richard Waters, 1462 Darby Rd., Sebastopol, CA 95472. A demo cassette is available for $8.00.

OUTSIDE SOUND: An Exploration of Sound as an Artform. Exhibit at the San Francisco Arts Commission Gallery, 155 Grove St., San Francisco, CA, 94102, through October 29, 1988. Installations by Bob Hobbs and Tom Nunn, Philip Perkins & Barry Schwartz. Performances by Pamela Z (Saturday 10/1, 8:00 PM), Tim Perkis & Friends (Saturday, 10/15, 8 PM), and Bonnie Barnett (Saturday, 10/29, 3 PM).

"HOW TO PRODUCE & PROMOTE SMALL CONCERTS." It's not the last word, but a few good ones for those with ANY doubts. $5.00; Jeff Brown, 135 West 2nd St., Juneau, AK 99801.

CASSETTE TAPES FROM EMI: From the Pages of Experimental Musical Instruments, Volumes I, II and III are available from EMI at $6 apiece for subscribers; $8.50 for non-subscribers. Each tape contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny, beautiful and lively music. Order from EMI, PO Box 784, Nicasio, CA 94946.

UPCOMING PERFORMANCES BY SUSAN RAWCLIFFE using odd and exotic flutes and whistles: Oct. 9, 1988 at the Dairy Barn, Southeastern Ohio Cultural Arts Center (8000 Dairy Lane, Athens, Ohio, 45701), and Oct. 15 at 8 PM, Real Art Ways (94 Allyn St., Hartford, CT, (203) 525-5521).

The 1988 New Music America Festival takes place in Miami, Dec. 2-8. Works of many famous and not famous contemporary musicians from North and South America will be presented, including a number who work in sound installations, unconventional instruments and exploration of acoustic phenomena. For information write New Music America Miami, MDCC/Wolfson Campus, 300 NE 2nd Ave., Miami, FL 33132-2292, phone (305) 347-3768.

(continued on page 19)